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MASS SPECTROGRAPHIC ASSIGNMENT OF ACTIVITIES TO Re^{186} AND Re^{188}

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A sample of ammonium perrhenate solution was bombarded in the Argonne heavy water pile to produce the 18 and 90 hour activities summarized by Seaborg.[1] In order to verify the assignment of the activities to certain isotopes, the activated material was analyzed by a mass spectrograph. This was done in the following manner:

A portion of the activated solution was placed in a tungsten crucible and evaporated to dryness. This crucible was then placed in the source system of the mass spectrograph where it was heated and the emergent vapor ionized by electron bombardment. By operation of the spectrograph, the ions were separated according to mass and deposited on a photographic plate.

Before development, two successive radioautographs were made from this plate, the first for 36 hours and the second for 180 hours. The plate was then developed to provide mass markers.[2] Development of the transfer plates showed weak lines at masses 186 and 188 on the first plate. On the second plate only the line at 186 was observed, showing that the activity causing the exposure at 188 had a shorter half-life than that causing the exposure at 186.

A second portion of the original irradiated sample was followed by counting it concurrently with the production of the radioautographs. This showed the presence of 18 and 90 hour half-lives. Therefore, the 18 hour half-life is assigned to mass 188, and the 90 hour assigned to mass 186, in agreement with Goodman's assignment.[3]

In order to determine which isotope of rhenium is responsible for the resonance absorption for neutrons of 2.3 volts energy, two additional samples of ammonium perrhenate were bombarded, one inside an aluminum cylinder with negligible neutron absorption and the other inside a cadmium cylinder of thickness such that the 0.18 volt cadmium resonant neutrons were reduced to less than 0.1% of the initial flux, while the flux of neutrons of 2.3 volt energy was reduced to 88% of the initial flux. By counting the resulting activity it was found that the ratio of initial activities of 18 hour half-life to 90 hour half-life was about 7 for the sample which had been bombarded in aluminum, and 2.5 for that in cadmium. The ratio of the number of activated atoms is thus 1.4 : 1 for aluminum shielding, and 0.5 : 1 for cadmium shielding. From this we conclude that the 2.3 volt resonance leads to the 90 hour activity at mass 186.

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